

the most frequently taken is that by the storms of the United States, which pursue an easterly course through the lakes to the Gulf of St. Lawrence. A considerable number advance from Nova Scotia to Davis Straits, but the greater number take a north-easterly course through the Atlantic towards Iceland and the North Cape. Among other tracks less frequently followed, but of great importance commercially and otherwise, are these: from New Orleans, along the east coast of the United States, towards Nova Scotia; from mid-Atlantic to the south of Ireland, and thence through Europe to the northern shore of the Mediterranean, and from the Atlantic about 42° lat. and 40° long., in a north-easterly course, quite outside, but at no great distance from, the British Isles, and thence towards the North Cape. Of the tracks more immediately influencing British weather, are one from Iceland in a south easterly direction through the North Sea and Germany, and three tracks starting from near Sicily, one eastward through the north of Germany, the second to the north-east to Christiania, and the third through Ireland and the Hebrides, these being the storm-tracks which chiefly give the British Islands their easterly and northerly winds. Gen. Hazen's charts suggest valuable hints as to the times of the year when these and other important routes are most frequently taken by storms.

THE U.S. FISH COMMISSION AT WOOD'S HOLL¹

THE summer head-quarters of the United States Fish Commission is located at Wood's Holl, a village situated on the south side of Cape Cod, Mass., north of Martha's Vineyard. The coast scenery is pretty, and inland the country is undulating and partially clothed with forests of pines and other trees, which have mostly been planted within the last forty years. Wood's Holl and the neighbourhood is an increasingly favourite locality for the summer residences of the inhabitants of Boston, New Haven, New York, and other large towns in that part of the country, and already a colony of scientific men is making its appearance. Excursion steamers run frequently in the summer for the day trip from Newport and other places. As in the whole of that region of North America, the surface-soil is a thick deposit of glacial drift containing numerous boulders.

The site was selected on account of the purity of the water, owing to the absence of all fresh-water streams and presence of strong tidal currents which ensure a circulation of well-aërated water close to the shore, and also on account of the physical conditions which lead to a remarkable variety in the marine fauna being procurable within a short distance.

The warm current of the Gulf Stream, which sweeps up the eastern coast of the States, here becomes diverted by Cape Cod, and passes out into the Atlantic. This causes the pelagic fauna to be well represented, and were the local conditions of the coast more favourable it would cause the littoral fauna to be particularly rich. The cold currents from the north extend down the coast as far south as Cape Cod, which practically forms the southern limit of the Arctic littoral fauna. The narrow neck of the Cape thus separating two entirely distinct assemblages of animal forms. Lastly, the deep sea offers its peculiar fauna.

The site occupied by the Commission consists of a small spit of land, which was purchased by public subscription, and which has since been increased by reclamation.

At the present time the buildings of the Fish Commission are in a transition state. Formerly, the various

officers had to severally obtain what accommodation they could in the village. Last August, however, the staff moved into the residence-house which has been built for that purpose. The residence-house is a red brick, gabled structure, with plenty of outside woodwork, a style of architecture which is very common in New England. On the ground-floor is a large central hall, into which open Prof. Baird's office, the sitting-room, dining-hall, reading-room, and other offices. A portion of the first floor is reserved for Prof. Baird and his family, the remainder is devoted to the bedrooms of the married officers who have brought their wives—families to the extent of one baby only are allowed! The bachelors' rooms are on the second floor. The whole building is most comfortably furnished. All the staff take their meals together with the ladies.

Hitherto the summer work of the naturalists has been carried on in two roughly-fitted barns. One serves mainly as a storehouse for the trawls, collecting implements, and jars and bottles for preserving specimens. Here also is the laboratory where the chemical investigations on the water obtained at various depths and from different localities are carried on.

The other building, which is on the wharf of the Light-house Board, is mainly devoted to the temporary storage of the zoological collections and to the work-tables of the naturalists, all the fixtures are of a very simple character, and call for no special mention. It is here that the material brought in by the steamers is finally sorted and, as far as possible, determined and catalogued; the material collected, however, affords more than enough occupation for the winter months.

A commodious new laboratory is being built close to the residence house, which is expected to meet all the requirements of this most important section of the Commission. It will be a plain three-storied brick building, in the basement of which will be large tanks. The ground-floor will be thrown open to the public as a general aquarium, in which will be tanks of various sizes for the illustration of the marine fauna and for the breeding of fish, much as in our ordinary aquaria. The first floor will be devoted to the laboratories of the working naturalists, to which of course the general public will not be admitted. The second floor will be divided between the physical and physiological laboratories, photographic room, and other work rooms.

Between this building and the residence-house is the pumping-station, by means of which fresh and salt water can be continuously circulated throughout either building.

On the sea-frontage several large open basins or tanks are nearly completed, in which fish-hatching will be carried on on an extensive scale. Cod-hatching is to be tried next season. The tanks are large enough to breed sharks, were they required. The water in these tanks rises and falls with the tide, owing to the porosity of the outer walls and the existence of small gratings; the latter are, however, under perfect control. Prof. Verrill has suggested that it would be desirable to have a kind of iron and glass cage or diving-box made, which, while open above, could be let down into the largest tank, and in which a person could observe and sketch the marine life around him under the most favourable conditions.

A long wharf has also been constructed for the use of the steamers of the Commission, and which also serves as a breakwater.

The general scheme of the buildings leaves little to be desired, and doubtless many improvements and additions will suggest themselves from time to time.

Not far from the Commission buildings is a plot of ground, which has been secured for the purpose of building a teaching and research laboratory, to be supported by those universities and colleges which do not possess any similar facilities of their own. This appears to be a very wise provision, and doubtless the Commissioner

¹ Originally spelt and still pronounced "Wood's Hole." The name was changed by order of the Postmaster General in 1875.

will afford every possible facility to those who may work them.

Not less complete are the arrangements for the collection of specimens and for the observations on depth, surface and bottom temperatures, and other physical features.

Two steamers have been built for the Fish Commission—the *Fish Hawk* in 1880, and the *Albatross* in 1883.

The *Fish Hawk*, a steamer of 484 tons of displacement and 205·71 tons measurement, was built particularly for use in the hatching of shad-eggs. Although unsuitable for long voyages or rough weather, she has proved a valuable boat for short trips and for dredging down to a depth of about 700 fathoms, having been well furnished with modern apparatus. Already much important work has been accomplished in the vessel in her subsidiary capacity, as is proved by the publications of the Fish Commission and Prof. Verrill's articles in *Science*, &c. (*Science*, vol. i. 1883, pp. 443, 531, and vol. ii. 1883, p. 153).

Last year the new steamer *Albatross* was specially constructed for deep-sea trawling. The extreme length of the vessel is 234 feet, the breadth of beam, moulded, is 27½ feet; the registered net tonnage is 400 tons, and the displacement, on a 12-foot draught, 1000 tons. She is most perfectly fitted with all those improvements in collecting and observing tackle which considerable experience has proved to be the best; but improvements and adaptations are continually being suggested. A full and illustrated account of the vessel is given by Mr. R. Rathbun in *Science*, vol. ii. 1883, pp. 6, 66. Suffice it now to mention that the comfort of the staff is as well provided for as their scientific necessities, and a complete system of electric lighting enables the laboratory work to be carried on at all hours. The main laboratory is 20 feet long, 26 feet wide, and 7 feet 10 inches high, and is situated amidships: above this is a well-lighted deck laboratory.

So far we have very briefly detailed the mere appliances for the collection and preservation of specimens. A short sketch of the mode of work might prove interesting.

The steamers are manned by naval officers and crew, a plan which serves the double purposes of lessening the expenses of the Commission and of spreading an interest in marine zoology throughout the navy. The officers have proved themselves to be most zealous in the work, and have cordially assisted the civilian staff in every possible manner; several important improvements in dredging and sounding apparatus have originated from some of them.

The sailors, too, take a personal interest in their occupation, and occasionally bring rare forms to the naturalists, which they have themselves caught in a hand-net.

Before an expedition, Prof. Baird consults with Prof. Verrill on desirable localities to explore, and instructions are given to the Commander, who also has charge of the mechanical portion of the dredging operations.

Mr. Benedict is the naturalist in charge of the vessel, and he is responsible for the specimens directly they arrive on deck; usually one or two naturalists work under his directions, the arrangement being that each is responsible for one or more groups of animals.

The contents of the trawl are subjected, immediately on their arrival on deck, to a process of sifting through a series of sieves of different sized meshes, and most of the animals are forthwith preserved. Numerous methods of conservation have been tried, but it is found that, under the special circumstances, alcohol is the best for general purposes. In some instances the jars have to be kept in ice to preserve the tissues whilst the alcohol is slowly penetrating; picric, chromic, osmic, and other acids and reagents, are used when deemed necessary. As a general rule, pelagic forms are killed by picric acid. All but the largest and smallest animals are put into glass-capped

"butter-" and "fruit-jars," which are secured by a screw-down metal cap. Various devices are resorted to for large specimens; the smallest are placed in homœopathic vials.

Each dredging "station" has its serial number, and a full record of the position, depth, bottom and surface temperatures, with other details, is kept, and a label, bearing the number of its station, with certain other information, is put into each bottle of specimens. Mr. Benedict has a small hand-press on board, and he often prints such labels whilst the trawl is out. So far as opportunity presents, the species or groups are roughly sorted on board, and are then ready for identification in the laboratory. Excepting in the case of large quantities of common species, all the specimens from each haul are retained. Surface skimmings are similarly treated.

All the material so obtained passes through Prof. Verrill's hands, and he distributes certain groups to specialists to be worked out after he has described those forms which interest him. The zoological work of the Commission is so well known that it would be superfluous to even enumerate the naturalists on the staff.

After having been duly entered, the specimens, if properly named, are broken up into sets, of which the first naturally goes to the National Museum at Washington, the second to Prof. Verrill, the third to the Museum of Practical Zoology at Harvard University, Cambridge, Mass., and the remaining sets are variously distributed or kept in the stores as duplicates.

The Marine Laboratory is only officially open during the summer months. During the remainder of the year most of the officers are at Washington employing their time in identifying specimens, drawing up reports, and other routine work.

The biological portion of the work of the Commission is not merely restricted to the collection and identification of species; careful drawings are being made of every form collected, with a view to illustrating the entire fauna of that coast. The numerous papers of Prof. Verrill, Dr. Ryder, and others, prove that anatomical and embryological investigations are not neglected; life-histories are studied, and all possible data are collected on the influence of environment on organisms. It is intended, when the new building is completed, that the physiology of marine forms shall receive a due share of attention.

One object of the Commissioner is to thoroughly study the fauna of the American waters, fresh and salt, and encouragement and facilities are given to all the officers to follow their personal bent, of course paying a due regard to routine work. Naturally, at present, the officers are more engaged in the recording of species, since this pioneering work is the necessary precursor to morphological investigation; but the lines of the Commission are laid on too broad a scale to limit the original research of any officer.

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ANCIENT AIR-BREATHERS

WHILE the records of the life of the sea have been preserved in abundance from early geological periods down to the present time, the chronicles of the living things of the land are comparatively scanty. The early history of land-animals has therefore a peculiar interest, heightened by the rarity of the evidence from which the history must be compiled. Considerable progress, however, has recently been made in this department of investigation. Within a few years, discoveries of the remains of scorpions and insects have successively been made in older and older strata, till now they have been disinterred almost simultaneously from older Palæozoic rocks in three different countries of the old world. Scorpions, which appear to be the most ancient type of air-breathing arachnids, have been found to be comparatively abundant in the lowest Carboniferous strata. The